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ABSTRACT

Success of Native American Students in science and science-related careers has long been a dilemma for those educators in the population-at-large that seek to improve the representation of all minorities in fields of science and engineering. This study was conducted to investigate the cross-cultural nature of attitude toward science and reservation-boundness with students of two races both on and off the reservation. Three populations were identified: (1) Native Americans in reservation schools; (2) non-Native Americans in reservation schools; and (3) non-Native Americans not in reservation schools. Data from the study, including overall and subscaled values, point to three significantly different populations, two of which were operating on the same turf. Results indicate that even though Native Americans and non-Native Americans on the reservation were significantly different in overall values, subscaled scores showed they were more like each other than like their nonreservation peers. Yet, a more complete analysis of subscaled values showed non-Native Americans on the reservation interpreted instrument questions in a manner more like their nonreservation peers than like their Native American peers. (Author/CW)

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A Cross-Cultural Study of Attitude Toward Science and Related Influential Factors

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Abstract

A Cross-Cultural Study of Attitude Toward Science and Related Influential Factors

Success of Native American students in science and science-related careers has long been a dilemma for those educators in the population-at-large that seek to improve the representation of all minorities in fields of science and engineering. As a result of a preliminary study concerning attitude of secondary Native American students on a South Dakota reservation, this study was conducted to extend those findings by investigating the cross-cultural nature of attitude toward science and reservation-boundness with students of two races both on and off the reservation. Three populations (N = 244) were identified and they were--Native Americans in reservataion schools, non-Native Americans in reservation schools, and non-Native Americans not in reservation schools.

Data from the study, including overall and subscaled values, point to three significantly different populations, two of which were operating on the same turf. Results indicate that even though Native Americans and non-Native Americans on the reservation were significantly different in overall values, subscaled scores showed they were more like each other than like their nonreservation peers. Yet, a more complete analysis of subscaled values showed non-Native Americans on the reservation interpreted instrument questions in a manner more like their nonreservation peers than like their Native American peers. Further analysis of culture is suggested before linking attitude toward science with race and reservation-boundness.

A Cross-Cultural Study of Attitude Toward Science and Related Influencial Factors

Success in school science is a result of a variety of experiences and characteristics, some of which come from within the individual while others may be in the environment. One such characteristic that has received considerable attention in science achievement studies is a positive attitude toward the fundamental activities engaged in by scientists, the process of science. Since early studies by Brown (1955) revealed a positive correlation between attitude and achievement in science, numerous investigators have explored this relationship.

Attitude has been described as a preconditioner for all human behavior. It varies in intensity and increases or decreases the probability for certain events to occur (Allport, 1967). Rokeach (1968) further refined this description by pointing out that attitude is an expression of an enduring organization of beliefs around objects or activities that predispose an individual to respond in some preferred manner. Therefore in science class, attitude would influence students' perception of events and activities that occur in the classroom.

Inspite of the positive attention given attitude studies in the literature, definitive evidence does not exist to show that attitude promotes achievement. Meta-analysis treatment of attitude-related studies suggest the relationship less significant than had been reported and in fact the alternative may be true, achievement promoting attitude (Willson, 1983). In a broader sense, achievement in science may be more closely

related to interest in science rather than psychologically scaled attitude. Bloom (1976) indicates that attitude-achievment relationships originate from a larger and more powerful attitude system, attitude toward school.

Native American Background

Success of Native American students in science and science-related careers has long been a dilemma for those educators in the population-at-large that seek to improve the representation of all minorities in fields of science and engineering. Like Bloom, educational data indicate that the difficulty extends beyond the academic fields of science and engineering and also includes the school experience in general (Comptroller General of the United States, 1975). As high as 60% of the young people on some reservations will drop out of school before reaching the 12th grade with children falling behind from 1/2 - 1 1/2 years by mid-elementary to from 2 - 2 1/2 years by the time they reach high school. Successful achievement in post-secondary education is even more limited.

Even though many investigators have provided evidence through the years to support the high intellectual potential of Native American youth (Havighurst, 1957; Erikson, 1963; Ruark, 1967; Purdy, 1968), such potential alone has not promoted successful achievement in school science or school itself. Factors beyond the classroom may need to be examined since culture and tradition may be having a greater influence on school achievement than what is currently recognized by educators.

Purpose

A preliminary study of attitude toward science for reservation-bound Native American secondary students was completed and reported earlier (Haukoos, 1986). In that study a reference population of equal size and grade level from the same rural state was used to determine patterns and departures from those patterns for Native American attitude values. Results indicated the populations were so distinctly different on their attitude toward science performance that additional populations were needed to provide greater clarity to attitude pattern development. As a result of those findings, this study was conducted to expand on questions asked by increasing the overall sample size five-fold and adding a third intermediate population for additional comparison. The new population consisted of non-Native American students who were reservation-bound and had experienced many of the same school educational opportunities as their Native American peers. It was hypothesized that these additions to the initial study would provide a more complete understanding of the attitude environment of the bicultural reservation schools and a more meaningful interpretation of results when compared to the nonreservation subjects. More specifically, the purpose of this study was to:

1) Determine the attitude toward science of three populations of secondary students--Native Americans in reservation schools, non-Native Americans in reservation schools, and non-Native Americans not in reservation schools.
2) Determine if there was a relationship between race and

attitude toward science scores.

3) Determine if there was a relationship between reservation-boundness and attitude toward science scores.
4) Determine if there was a relationship between prerequisite course work taken in science and attitude toward science scores.
5) Determine which subscaled attitude components related to race, reservation-boundness, and science course work taken.

Procedures

Data Sources and Treatment

Since the primary variable to be examined in the study was attitude of cross-cultural students toward science, 215 7th-12th graders enrolled in science courses in the Todd County Schools of South Dakota were administered an attitude-toward-science inventory. The district is the primary school unit serving the Sicangu Lakota people of the Western Teton Sioux on the Rosebud Reservation. Two populations were identified among those subjects, 75.8% were Native American while 24.2% were non-Native American students. A third population was identified and it consisted of non-Native American students from the same school grades and rural setting but not reservation-bound. These 29 students from throughout South Dakota were paper presenters at the South Dakota Junior Academy of Science. They provided a reference point from which to compare attitude toward science within the State of South Dakota. An analysis of study populations by grade-level and

race is presented in TABLE I.

Data analysis in a cause-comparative design was based upon attitude values derived from survey instrument scores and subscores for the three populations. Tests to determine significance among the populations were determined with a one-way analysis of variance and a follow-up multiple range test on subscales where the F-ratio was shown to be significant. The Pearson product-moment was used to determine correlation coefficients between the number of prerequisite science courses taken while in secondary school and attitude toward science scores.

Instrumentation

All participants were administered a backgound data form and the Science Attitude Inventory (SAI) (Moore and Sutman, 1970), an instrument designed for secondary school students. The SAI is a 60-item Likert-type instrument with a 4-point agree-disagree response scale. Its six primary subscales were used to probe more deeply into attitude characteristics of the subjects. Each of these is additionally divided into positive and negative subsets for more complete analysis and scoring.

Face validity of the SAI was established by submitting an original collection of items to a panel of judges and a group of high school students. Construct validity was established by field testing the instrument with three groups of high school students--a control group, a positively taught group, and a negatively taught group. Groups receiving specific treatment scored significantly in the direction established with test-

retest reliability for the control group at 0.93. In addition, reliability was determined to be 0.93 through test-retest methodology (Moore and Sutman, 1970).

Results

Analysis of SAI data from the three populations were first subjected to the one-way analysis of variance to validate the assumption that there was no difference in mean subscale and overall scores among the populations. Mean values and standard deviations to determine signifiance among the three populations are presented in TABLE II. Overall, non-reservation students from throughout South Dakota did have the highest mean scores while the Native American students on the reservation had the lowest. F-ratios resulting from ANOVA analysis at the .05 level of significance indicate the three populations were significantly different on overall scores for the SAI and also on 11 of 12 instrument subscales (TABLE III). A multiple range test for variability was used to identify the differences and these are visually representation in TABLE IV. Results can be summarized as follows:

1) Native American and non-Native American reservation-bound students were more alike (6 of 12 subscale variables) than different (4 of 12 variables).
2) Native American and non-Native American nonreservation-bound students were much more different (11 of 12 subscale variables) than alike (1 of 12 variables).
3) Non-Native American reservation-bound and non-Native

American nonreservation-bound students were much more different (9 of 12 subscale variables) than alike (2 of 12 variables).

4) All three populations were alike on one subscore and differed from each other on three of twelve subscores.
5) Total SAI scores for the three populations indicate each population was different form the other.

When correlating the number of science courses student had taken so far in their secondary school experience with each of the SAI subscales and overall values, there were significant coefficients for 11 of the 12 subscales and overall values (TABLE V). Although there were significant correlation coefficients between attitude and course work variables, all r-values for subscale scores ranged from .08 to .31 with an overall coefficient less than .45. Therefore, data indicate only a slight relationship between these two variables.

Discussion and Conclusions

Initially, it was hypothesized that if Native American student attitude toward science could be identified from scaled knowledge of various components of science reflected in the SAI, some solutions to greater achievement and participation in science might be forthcoming. Disparity on attitude measures between Native American students and non-Native American students not reservation-bound was expected in the preliminary study but not to the extent it was exhibited. With the greater overall N-value and the addition of the third population to the study, non-Native Americans on the reservation,

conclusions seem somewhat more distinct in this cross-cultural environment and therefore results can be interpreted with greater clarity.

First of all, attitude scores overall in this study indicate three distinctly different populations as far as attitude toward science was concerned. As Rokeach (1968) pointed out, attitude is an expression of an enduring organization of beliefs around objects or activities. One may infer then that each population, Native Americans reservation-bound, non-Native Americans reservation-bound, and non-Native Americans non-reservation-bound had different experiences in life from which to organize beliefs about science. Non-Native Americans from throughout South Dakota had taken classes for the most part with peers and teachers with European ancestry, most of which had little everyday knowledge of Native American people or their culture. On the other hand, both populations on the reservation did share many similar experiences both in and out of the school even though their home race or culture may have differed. Resulting data from the subscale portion of the study indicate the reservation populations more alike than different on their attitude toward science, yet overall scores suggest the home race or culture may have influenced the outcome difference.

Since one of the objectives of the study was to identify subscale components of the attitude measure more closely associated with race or reservation-boundness, it was noted that Native American students responded differently than their non-Native American peers to the positive and negative subscale values of the instrument. While Native American students were

like their non-Native American reservation peers on 5 out of 6 positive subscale values, they differed from those same peers on 4 out of 6 on the negative scale. Such results suggest that racial culture operates somewhat more subtly than society might expect. In this case, Native Americans seem to interpret positive and negative statements differently than their European descendant counterparts. If this is true, cultural bias may exist in the instrument in places not anticipated by its authors. Other overall and subscale patterns by race were not identified among the populations and the slight correlation between the number of prerequisite courses taken in science and attitude values suggests certain behaviors less influential than others.

An inquiry into cultural heritage of Native American people indicate they do not share in a detached, objective, and analytical view of nature as many other societies. They view the human relationship with nature as highly spiritual, a relationship where natural phenomena receive spiritual explanation (Robbins, 1983). Even though a number of investigators have indicated little or no difference between Native American and non-Native American peoples on traditional intelligence measures (Ruark, 1967; Purdy, 1968) or on the rate of developing various intellectual skills (Cohen, 1985), attitude values reported here do not follow the same pattern.

The results of this study indicate racial culture and reservation-boundness do influence attitude toward science. Yet, further analysis of cultural factors is needed to more clearly link cultural experiences and environment with attitude toward science.

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TABLE I

Population Demographics

	Native American	Non-Native American		
Grade	Reservation	Reservation	Nonreservation	Total
7	53	17	-	70
8	26	7	4	37
9	36	11	5	52
10	41	13	6	60
11	7	1	9	17
12	0	3	5	8
Total	163	52	29	244
Valid %	66.8	21.3	11.9	100.0

TABLE II

Means and Standard Deviations for Significance in Analysis of Variance

	Native American Reservation (N=163)		Non-Native American Reservation (N=52)		Non-Native American Nonreservation (N=29)	
Subscale Variables	Mean	S.D.	Mean	S.D.	Mean	S.D.
1A	8.84	2.48	9.11	2.59	11.62	2.21
B	7.03	2.26	8.33	2.78	10.69	2.50
2A	8.83	2.40	9.52	3.11	10.19	2.61
B	8.40	2.67	10.02	2.67	10.48	2.29
3A	7.55	2.23	8.14	2.82	9.67	2.73
B	8.09	2.64	10.46	2.55	12.59	2.57
4A	8.47	2.38	8.52	2.61	10.52	2.08
B	6.15	2.36	5.97	3.25	5.33	2.43
5A	8.60	2.74	8.99	3.04	10.88	2.51
B	8.15	2.66	9.73	2.83	11.90	1.84
6A	7.93	3.87	8.20	3.19	12.17	3.09
B	7.87	2.83	8.60	3.27	12.47	2.89
Total	96.02	2.64	105.39	2.39	128.50	2.48

TABLE III

Significant One-Way Analyses of Variance

Variables	DF	SS	MS	F	SIG
1A Subscale					
Between groups	2	191.28	95.64	15.63	.001*
Within groups	241	1474.85	6.12		
Total	243	1666.13			
1B Subscale					
Between groups	2	351.53	175.76	33.52	.001*
Within groups	241	1263.71	5.24		
Total	243	1615.24			
2A Subscale					
Between groups	2	54.96	27.48	4.10	.018*
Within groups	241	1616.30	6.71		
Total	243	1671.26			
2B subscale					
Between groups	2	176.68	88.34	12.80	.001*
Within groups	241	1663.30	6.90		
Total	243	1839.98			
3A Subscale					
Between groups	2	114.08	57.04	9.69	.001*
Within groups	241	1418.91	5.89		
Total	243	1532.99			
3B Subscale					
Between groups	2	614.23	307.11	44.92	.001*
Within groups	241	1647.58	6.84		
Total	243	2261.80			
4A Subscale					
Between groups	2	106.01	53.00	9.22	.001*
Within groups	241	1385.07	5.75		
Total	243	1491.08			
4B Subscale					
Between groups	2	16.92	8.46	1.27	.282
Within groups	241	1601.51	6.65		
Total	243	1618.43			
5A Subscale					
Between groups	2	128.56	64.28	8.32	.001*
Within groups	241	1862.85	7.73		
Total	243	1991.41			
5B Subscale					
Between groups	2	388.43	194.21	28.38	.001*
Within groups	241	1649.39	6.84		
Total	243	2037.82			
6A Subscale					
Between groups	2	418.95	209.47	18.84	.001*
Within groups	241	2678.97	11.12		
Total	243	3097.92			
6B Subscale					
Between groups	2	520.42	260.21	30.20	.001*
Within groups	241	2076.40	8.62		
Total	243	2596.82			
Overall Total					
Between groups	2	26786.84	13393.42	74.33	.001*
Within groups	241	43423.34	180.18		
Total	243	70210.18			

* Significant at or below the 0.05 level, two-tail test.

TABLE IV

Visual Representation of Multiple Range Test Results Identifying Differences Among Populations*

Subscale Variables	Native American Reservation	Non-Native American Reservation	Non-Native American Nonreservation
1A	----------	----------	--------
B	--------	--------	--------
2A	--------		--------
B	--------	----------	
3A	----------	----------	--------
B	--------	--------	--------
4A	----------	----------	--------
B		None	
5A	----------	----------	--------
B	--------	--------	--------
6A	----------	----------	--------
B	----------	----------	--------
Total	--------	--------	--------

* All lines indicate one or more populations significantly different from other populations.

TABLE V

Pearson Correlation Coefficients for the Relationship Between Prerequisite Science Courses Taken and Attitude.

Subscale Variables	r	r^2 *	p
1A	.280	.078	.001**
B	.269	.073	.001**
2A	.227	.051	.001**
B	.086	.007	.090
3A	.297	.088	.001**
B	.311	.097	.001**
4A	.265	.070	.001**
B	-.196	.038	.001**
5A	.156	.024	.007**
B	.304	.092	.001**
6A	.277	.077	.001**
B	.276	.076	.001**
Total	.435	.189	.001**

* Per cent of variance responsible for r.
** Significant at or below the 0.05 level, two-tail test.